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Probabilistic Approaches to Quantity Determination and Price Evaluation in System Acquisition

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Probabilistic Approaches to Quantity Determination and Price Evaluation in System Acquisition

Abstract

Quantity uncertainty is a very real problem experienced in the acquisition of systems. Particularly when the systems have a diverse customer base and contracts span several years, exact quantities can be difficult to estimate. Typically, program managers guess at the most probable quantity and use that estimate to drive the Request For Proposals (RFP) and subsequent source selection. When the actual quantity purchased differs from the estimate, additional source selections or renegotiations are needed, usually driving up the unit price in the process. Two alternative probabilistic methods are presented that deal with this problem, with the effect of reducing the quantity uncertainty risk. One substitutes a probabilistically estimated quantity (PEQ) for the most probable quantity, often called the best estimated quantity (BEQ) in government acquisition. The second, called the Probabilistic Evaluation of Price (PEP), abandons the estimate altogether in favor of requiring bid prices for all possible quantities. These bid prices are then combined probabilistically into an overall evaluation price. The two methods are presented with the help of a simple example, and the lessons learned from implementation in a major joint program are included to address advantages and limitations gleaned from actual experience.

Probabilistic Approaches to Quantity Determination and Cost Evaluation in System Acquisition

INTRODUCTION

One of the biggest challenges in system acquisition, as in life, is uncertainty. Often the Request for Proposal (RFP) technical requirements are drafted in painstaking detail, while the quantities are a simple point estimate. When the time comes to exercise contract options, one of two things is likely to happen. The first is that the quantity required is lower than the estimate used in the source selection. In this case, the buyer is either forced to buy unneeded units or renegotiates and pays a higher price. The second possibility is that the quantity needed goes up. In this case, the buyer must either conduct a new source selection for the additional units (probably at a higher price) or must renegotiate with its sole source (definitely at a higher price). The result of using a point estimate of the quantity, then, is increased procurement risk, which generally translates to higher cost in the long run.

This paper describes the use of probability theory in system acquisition, and presents two methods of employing it. In the first, the full range of possible quantities is listed and each is assigned a probability of occurrence based on careful market research. These probabilities are then used to calculate a more realistic "point estimate" of the quantity. The second, more robust method expands upon this concept, while abandoning the point estimate methodology altogether in favor of a probabilistic price evaluation. A variation of the latter method was used successfully in a $200 million source selection for the Joint Tactical Information Distribution System (JTIDS) in 1996, and lessons learned from its use are woven throughout the following discussion.

The remainder of the paper is organized into two major subheadings: Methods and Implementation Issues. The Methods section begins with a discussion of the point estimate

quantity, often called the best estimated quantity (BEQ) in government source selection. It also details the limitations of this approach, and describes the two alternative probabilistic approaches in detail using a simple example. Finally, it concludes with an illustrative comparison of the three methods. The Implementation section begins with a brief description of the JTIDS program. It then discusses the program conditions that make probabilistic methods attractive, and concludes with a list of their limitations and solutions to those limitations. The latter section draws heavily from the experience of the JTIDS source selection.

METHODS OF QUANTITY DETERMINATION AND COST EVALUATION

Best Estimated Quantity (BEQ)

Historically, source selections have used a "best estimated quantity," or BEQ, to convey quantity requirements to potential bidders. In essence, the BEQ represents the quantity that will most likely be purchased over the life of the contract. As with any point estimate, however, the true quantity will almost certainly fall either above or below. Knowing this, contractors are in effect encouraged to bid low at the BEQ, in hopes that they can make up the difference when the quantity changes. This is particularly true when price is either the only evaluation criterion or a disproportionately weighted criterion. Figure 1 illustrates a notional example in which the bid price at the BEQ is low, and increases as the quantity changes. To the left of the BEQ, renegotiation for a smaller quantity drives the unit price up while to the right, either additional procurements or renegotiation can drive the unit price up. By applying simple probability theory, however, the unit price curve can be effectively flattened out, thereby reducing the risk of long-term cost increases.

(Insert Figure 1 here)

Alternative Probabilistic Methods

The following section begins with a short primer on discrete probability distributions to lay the foundation for discussion of two probabilistic methods. It then presents a simple example, which is used to help illustrate their use.

Discrete Probability Distributions

A discrete probability distribution is composed of a finite set of values (x_i), each with an associated probability of occurrence $p(x_i)$. In any discrete probability distribution, the expected value is simply the sum of the products of all possible outcomes and their associated probabilities of occurrence. Equation 1 illustrates this property mathematically (Ross 2000).

$$E(X) = \sum_{i=1}^{N} (x_i * p(x_i)) \qquad (1)$$

Where x_i = i^{th} possible value of x
$p(x_i)$ = probability of x_i occurring
N = number of possible values of x
E(X) = expected value of x

Another property of the discrete probability distribution is that the sum of all probabilities is equal to 1. This stands to reason, since there is a total of 100% probability that must be divided among all possible values of x.

There are two ways equation (1) can be applied to a source selection. In the first, the expected quantity is calculated and used in lieu of the BEQ. This means that probability theory is applied on the "front end" to calculate a more realistic BEQ. In the second, probability is applied to the evaluation of price, in effect applying it to the "back end" of the process. In the latter case, the concept of a BEQ is disregarded altogether in favor of requiring bids for all

possible quantities. Before discussing the two methods, the following example is presented to clarify the discussion.

Example

In this example, assume that between 1 and 5 units of an item will be bought on a contract and the "traditional" BEQ is 4. Three scenarios are used to illustrate below, each representing a successively higher level of uncertainty in the actual quantity that will be purchased.

(Insert Table 1 here)

The first scenario in Table 1 represents a case where there is a relatively small amount of uncertainty. There is a high probability (0.5) that the actual quantity will be 4, with a lesser probability (0.2) that it will be 3 or 5. A very small probability exists that the quantity will drop to 1 or 2 units. Scenario 2 represents a moderate level of uncertainty, where we have less confidence in the BEQ ($p(x) = 0.4$). The remainder is spread over the remaining quantities. Finally, the third scenario represents total uncertainty within the range of possibilities, with each being assigned an equal probability of 0.2.

Probabilistically Estimated Quantity (PEQ)

The first, and simpler, of the two methods involves using probability to calculate a more realistic BEQ, which is then used to evaluate price in much the same way as the traditional BEQ. In this method, we simply calculate the expected quantity using equation (1) and use it in lieu of the BEQ. For the example scenario 1, the expected quantity is then

$$PEQ = E(X) = (1)(.05) + (2)(.05) + (3)(.2) + (4)(.5) + (5)(.2) = 3.75$$

Similarly, the expected quantity is calculated for scenarios 2 and 3 to yield the following:

(Insert Table 2 here)

Table 2 illustrates an important advantage to using a probabilistic approach. In scenario 1, where there is a relatively low level of uncertainty in the quantity, the expected quantity E(X) approaches the BEQ. This stands to reason, and underscores the fact that the BEQ is perfectly acceptable *when the quantity is known.* As uncertainty rises, however, E(X) can deviate significantly from the BEQ. It should be noted that while E(X) is relatively close to the BEQ in this simplistic example, for a large contract with a wide range of possible quantities the difference could be significantly greater. The PEQ (i.e. E(X)) therefore provides a more realistic and robust quantity at which to evaluate the cost of a proposal. Although E(X) is likely to be non-integer, it is a simple matter to either round off or to ask for a bid price at the two surrounding integers.

Probabilistic Evaluation of Price (PEP)

The second method presented is more robust than the first, since it provides incentive to bidders to offer a reasonable price across the entire range of possibilities, thus reducing program risk. The Probabilistic Evaluation of Price (PEP) method abandons the BEQ altogether, in favor of enumerating all potential quantities and receiving a bid price for each. The bid prices then become the x_i's in equation (1), and E(x) is now the expected cost of the contract. The probabilities $p(x_i)$ remain as in the PEQ. Table 3 presents notional bids for each potential quantity in scenario 1 of the example, and the associated calculation of expected cost. In this case, the expected cost of the contract is \$111.25, which is the value used to evaluate the cost portion of the proposal.

(Insert Table 3 here)

Effects on Bidding, Contract Price, and Risk

Table 4 presents a notional bidding strategy that contractors might use in the example given the three strategies (BEQ, PEQ, and PEP) discussed above. Using the BEQ method, the cost evaluation generally favors the bidder offering the lowest price at the BEQ. There is therefore incentive to offer a low price at the BEQ and compensate when renegotiation or additional procurements become necessary because of quantity changes. Using the PEQ in lieu of the BEQ, bidders have a more realistic picture of the probabilities and are offered incentive to flatten the price curve at and around the expected quantity. The expected quantity is also more likely to be accurate, reducing the risk of quantity changes. This method, of course, may result in slightly higher prices at the PEQ due to the increased risk born by the bidders. Finally, using the Probabilistic Evaluation of Price (PEP) method, where all prices affect the evaluation, bidders are offered an incentive to bid more evenly across the entire range of possibilities. Again, the price at the BEQ will undoubtedly be higher, but the risk of cost increases due to quantity changes is nearly eliminated.

(Insert Table 4 here)

(Insert Figure 2 here or following the next paragraph)

Figure 2 shows the example bids and costs from Table 4 (Scenario 2: Moderate risk of quantity changes) in graphical form to illustrate the effects of the three methods. Although the example is notional, it shows the desired effects of using probabilistic methods. The BEQ method results in a "bath tub" price curve, with a low price at the BEQ and higher costs elsewhere. The PEQ flattens the curve at values near the BEQ, but rises sharply at the ends. The PEP, in contrast, flattens the curve across the entire range of possible quantities.

From the discussion and notional examples presented to this point, the reader should have an understanding of the two probabilistic methods and how they relate to the BEQ method in terms of execution and desired effects. The remainder of the paper provides a discussion of the advantages and limitations of the probabilistic approach, noted during its implementation in the JTIDS program.

IMPLEMENTATION ISSUES

Probabilistic Evaluation of Price (PEP) was implemented in a 1996 source selection for the Joint Tactical Information Distribution System (JTIDS), an Acquisition Category ID joint program. JTIDS terminals provide jam-resistant digital communication of data and voice for command and control, navigation, relative positioning, and identification. The primary function of JTIDS is to distribute tactical information in digital form. JTIDS technology also locates and identifies subscribers with respect to other users. It is capable of transmission rates far above those of most existing communication systems. Platforms range from Marine ground-based trucks to Navy ships to Air Force fighters, AWACS, and JSTARS. The source selection referenced below was held to award the final production contract of terminals. Two contractors had been involved in the research and development, low-rate initial production, and full-rate production, and were the only companies realistically capable of performance.

The JTIDS program has many characteristics that illuminate the advantages of using a probabilistic methodology. In fact, these very characteristics drove the initial development of the methodology. At the same time, the actual experience helped to identify some of its limitations. The following discussion summarizes these advantages and limitations.

Conditions Favoring a Probabilistic Approach

Moderate-to-High Quantity Uncertainty

In the JTIDS program, all four U.S. military services had expressed requirements for ten different variants of the terminals and had personnel working in the Joint Program Office (JPO) at Hanscom Air Force Base. In addition, there were several NATO customers, one of which was represented in the JPO. The diverse customer base, each with its own line of funding, made quantity forecasting extremely difficult. Requirements projections would often change on a daily basis, depending on the funding posture of each service and NATO customer through time. Since JTIDS is a subsystem installed on various land, sea, and airborne platforms, the requirements were also subject to fluctuations in projected weapon system end-strengths. In addition, the contract spanned five years, making forecasts even more difficult. Firm requirements were a relatively simple matter for the first year, but for the four subsequent years the services were reluctant to commit due to budget uncertainties beyond the federal budget planning horizon.

In combination, the diversity of the customer base, budget uncertainties, and the time span of the contract made the quantities extremely difficult to forecast. This highly uncertain environment rendered the traditional BEQ approach inadequate. PEP methodology was therefore developed to reduce program risk while ensuring a reasonable price. In general, then, a probabilistic approach is ideal for programs with moderate to high quantity uncertainty.

Large Quantities

In addition to the uncertainty inherent in the environment, any contract that contains a large number and range of possible quantities will almost certainly experience an increased uncertainty component. In the simple example used earlier in this paper, the range of quantities varied only

from one to five. The room for variation, therefore, was small by definition. By contrast, in a contract with several hundred possibilities spanning multiple years, the room for variation can be significantly large. So the probabilistic approach is also ideal for programs buying large numbers of items.

High Cost Systems

Even when the quantities are large, the unit price may be small enough that the probabilistic approach is unnecessary. For expensive systems, however, cost increases can be significant if the BEQ method is used and subsequent buys differ from the BEQ to any degree. In the case of JTIDS, the terminals cost up to several hundred thousand dollars each. Clearly there was an advantage to enumerating the possibilities and receiving bids for each to reduce the risk of having to conduct subsequent procurements or renegotiations. The former can result in higher prices in addition to a costly source selection process. The latter can be even more costly, since it is likely that competition no longer exists because the losing bidders have shifted their efforts elsewhere.

Accurate, Current Cost Data

The final condition favoring a probabilistic approach can be considered a prerequisite. The program office must have current and accurate cost data from the bidders. Because the proposals will contain a large number of bid prices, each must be assessed for reasonableness. Any bid prices that are deemed unreasonable can then be included in the consideration of the technical evaluation in the form of risk. Without good cost data, it is very difficult in practice to discourage bidders from "gaming" the system.

Limitations

The most obvious limitation of the probabilistic approach is the set of conditions outlined in the previous section. The fact that the conditions exist, by definition, limits the approach's effectiveness to a subset of programs and procurements. Still, a great number of programs experience similar conditions, particularly major programs. The applicable subset is therefore arguably large. Several other limitations were noted during the development of the PEP, and are discussed below.

"Gaming" the System

Just as bidders can easily "game" the BEQ method, the possibility exists that they will attempt to game the probabilistic methods. The obvious strategy is bidding high at all quantities with low probabilities and low at those with high probabilities. In this way, the bidder gambles that the buyer will not buy at the highly probable quantities and, therefore, will make substantial profits on the less probable quantities. At the same time, the overall evaluation cost is lowered by the "lowball" bid prices. This risk can be greatly reduced if the source selection includes a technical evaluation that explicitly contains provisions for including cost risk. In other words, if the bidder offers prices at some quantities that are unreasonable, the technical evaluation will suffer. In a Best Value source selection, this allows the buyer to see the bidder's attempt to game the system and factor it into the evaluation. Using the BEQ, no such visibility exists. The same game can be played, but the buyer lacks the ability to see it and factor it into the award decision.

Watered Down Effects of Individual Bid Prices

In a large contract with many possible quantities, the individual contribution of each bid price can become almost negligible. This is particularly so for those quantities that have a low probability of occurrence. This can leave room for bidders to "game" the system, as discussed

above. One way to avoid this problem is to use a small range of weights, not necessarily corresponding to a probability. Another is to weigh each bid price equally and use the sum of all bid prices as the evaluation cost. The problem with either of these two methods is that the evaluation cost will no longer be the expected contract cost, as previously described. The reason for this is that the sum of the probabilities, or weights, may not equal one as before. The evaluation cost will now simply be a "figure" for comparison. Still, this poses no problem as long as the decision-maker understands the methodology.

Which Price Will the Buyer Pay?

Since the price of each unit will depend on the quantity bought each year, the buyer technically must order all quantities at once. In the JTIDS contract, a provision was inserted to require the government to commit by a certain cutoff date each year of the contract. The date must be early enough to determine the price level for that year's buy, but late enough to ensure that the budget has been resolved before any orders are placed. With that in mind, an ordering deadline in January might be reasonable for government procurements given that the fiscal year begins on October 1. After the ordering deadline, the buyer pays the price associated with the minimum quantity it is able to commit to buying at the deadline. For example, if the buyer can commit to buying 10 units by the deadline, the price at 10 units is used even if additional units are subsequently purchased in that fiscal year.

Convincing the Boss

As with any new technique, a major difficulty in implementation is convincing the decision authority that the technique is worth implementing in the first place. A prerequisite for this is a firm grasp of the concepts put forth in this paper, so that the idea can be articulated clearly. Particularly if the equal weighting variant is used, the decision-maker must also understand that

the evaluation "figure" does not correspond to a contract price. Still, even though the figure is somewhat nebulous, the desired effects on the bidding process can be achieved. The boss needs to understand this before he or she will agree to it. In the case of JTIDS, the methodology raised significant concerns in the contracting and financial management hierarchy during its development. A great deal of time was therefore spent vetting it at all levels and in all functional areas concerned. In the end, its unqualified success produced many "converts." The strategy worked exactly as designed.

Probability Estimation

The final limitation lies in the difficulty in estimating the probabilities associated with each quantity. Unfortunately, this process is highly subjective. In general, however, the buyer will have several subsets of requirements that can ease the process. Market research is the key. The first set consists of firm commitments, generally confirmed in writing by high-level decision-makers in all customer organizations. At the opposite end of the spectrum are the "wish list" requirements that have not been included in future budget estimates, but that the customer organizations are working to include. Between these two extremes, there may be several sets of requirements that have varying degrees of certainty. By stratifying the quantities in this way, realistic probabilities or weights can be applied relatively easily. In addition, the use of quantity zero (0), when market research supports that possibility, should be considered with the appropriate probability applied. Although somewhat counterintuitive, this option maintains a total probability of one, and therefore the integrity of the method.

Epilogue

Despite the challenges faced by the JTIDS JPO in developing and implementing PEP in its source selection, it worked as designed. The details of the evaluation methodology were clearly

communicated in the RFP, so that all bidders had a complete and common understanding of the process prior to submitting their bids. Examples were articulated clearly in the RFP and questions were answered for clarification wherever necessary. To ease the process for both the evaluation team and the bidders, a spreadsheet accompanied the RFP that contained all quantities, their probabilities, and the formulas for calculating the total cost (See Appendix).

One bidder submitted a proposal that attempted to "game" the system as discussed above. As a result, increased technical risk associated with the low prices was assessed in the evaluation. The contract was therefore awarded to the competing bidder, even though its evaluation price was higher. The resulting contract contained a flat set of costs for each terminal type, covering all potential quantities, spares, and warranty repair throughout the 5-year span. The risk of additional source selections or renegotiation of the existing contract was effectively eliminated. In fact, this methodology subsequently withstood the scrutiny of the General Accounting Office (GAO) when the losing bidder submitted an unsuccessful protest against the government's award decision.

CONCLUSIONS

Probabilistic techniques have been used in a wide range of operational settings for decades. This paper presented two ways to implement these techniques in the acquisition of systems. For procurements that have a moderate to high degree of quantity uncertainty, entail buying large quantities, span multiple fiscal years, and have high unit costs, these methods are ideally suited to reducing risk and cost in the long run. Careful market research must be conducted, however, to estimate probabilities associated with different quantities. If the guidelines offered in this paper are followed, and it cautions heeded, the result can be a long-term reduction of risk that can significantly reduce life-cycle costs.

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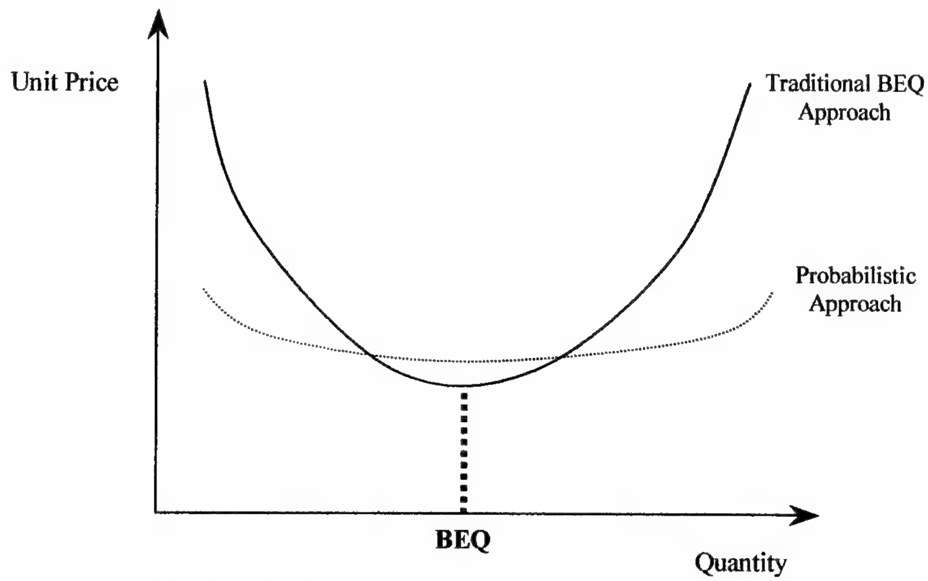

Figure 1. Notional example of the relationship between unit price and actual quantity purchased for BEQ and Probabilistic Approaches.

Table 1. Example Data

Scenario	***Probability of Buying x_i Units***				
$x_i \longrightarrow$	***1***	***2***	***3***	***4***	***5***
1	0.05	0.05	0.20	0.50	0.20
2	0.10	0.15	0.20	0.40	0.15
3	0.20	0.20	0.20	0.20	0.20

Table 2. BEO and E(x) for Examnle

Scenario	*BEQ*	*E(x)*
1	4	3.75
2	4	3.35
3	4	3.00

Table 3. Calculation of the expected contract cost using PEP for scenario 1

Quantity	***1***	***2***	***3***	***4***	***5***
Bid Price x	125	120	110	110	110
p(x)	0.05	0.05	0.2	0.5	0.2
x*p(x)	6.25	6.00	22.00	55.00	22.00
E(x) = Σx*p(x)	6.25 + 6.00 + 22.00 + 55.00 + 22.00 = 111.25				

Table 4. Notional Costs for Example Problem
(Figures in parentheses reflect higher costs resulting from additional procurement actions and renegotiations)

Scenario	*Quantity*	*BEQ Bid*	*PEQ Bid*	*PEP Bid*
1	1	(130)	(130)	125
	2	(120)	(120)	120
	3	(110)	105	110
	4	100	105	110
	5	(110)	(110)	110
2	1	(135)	(135)	125
	2	(125)	(125)	115
	3	(115)	110	115
	4	100	110	115
	5	(115)	(115)	115
3	1	(150)	(135)	120
	2	(135)	(120)	120
	3	(120)	100	120
	4	100	(120)	120
	5	(120)	(135)	120

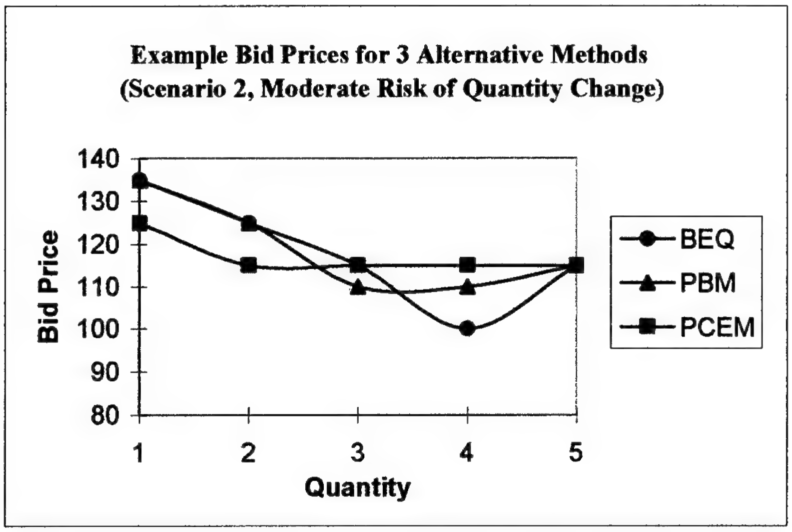

Figure 2. Example Bid Prices for BEQ, PEQ, and PEP

APPENDIX

Spreadsheet Included in the Request For Proposals, Joint Tactical Information Distribution System (JTIDS) Full-Rate Production (FRP) Contract, 1996 (Excel® spreadsheet file available from the author upon request)

	FY 97					FY 98					FY 99				
	Qty	Weight %	Total Price	Avg Unit Price (AUP)	Weighted AUP	Qty	Weight %	Total Price	Avg Unit Price (AUP)	Weighted AUP	Qty	Weight %	Total Price	Avg Unit Price (AUP)	Weighted AUP
Configuration 1	$\boxed{0}$	45.00%		$0	$0	$\boxed{0}$	25.00%		$0	$0	$\boxed{0}$	20.00%		$0	$0
(F-15/MAOC)	1	25.00%		$0	$0	1	20.00%		$0	$0	1	16.00%		$0	$0
	2	20.00%		$0	$0	2	11.00%		$0	$0	2	16.00%		$0	$0
	3	10.00%		$0	$0	3	11.00%		$0	$0	3	16.00%		$0	$0
						4	11.00%		$0	$0	4	16.00%		$0	$0
						5	11.00%		$0	$0	5	16.00%		$0	$0
						6	11.00%		$0	$0					
Configuration 2	8	6.25%		$0	$0	$\boxed{0}$	25.00%		$0	$0	$\boxed{0}$	20.00%		$0	$0
(E-3)	9	6.25%		$0	$0	1	7.50%		$0	$0	1	13.33%		$0	$0
	10	7.50%		$0	$0	2	7.50%		$0	$0	2	13.33%		$0	$0
	11	7.50%		$0	$0	3	7.50%		$0	$0	3	13.33%		$0	$0
	$\boxed{12}$	45.00%		$0	$0	4	7.50%		$0	$0	4	13.33%		$0	$0
	13	7.50%		$0	$0	5	7.50%		$0	$0	5	13.33%		$0	$0
	14	7.50%		$0	$0	6	7.50%		$0	$0	6	13.33%		$0	$0
	15	6.25%		$0	$0	7	7.50%		$0	$0					
	16	6.25%		$0	$0	8	7.50%		$0	$0					
						9	7.50%		$0	$0					
						10	7.50%		$0	$0					
Configuration 3	1	5.00%		$0	$0	1	5.00%		$0	$0	$\boxed{0}$	20.00%		$0	$0
(E-2C)	2	8.75%		$0	$0	2	5.00%		$0	$0	1	8.89%		$0	$0
	3	10.00%		$0	$0	3	12.50%		$0	$0	2	8.89%		$0	$0
	$\boxed{4}$	45.00%		$0	$0	4	12.50%		$0	$0	3	8.89%		$0	$0
	5	10.00%		$0	$0	$\boxed{5}$	25.00%		$0	$0	4	8.89%		$0	$0
	6	8.75%		$0	$0	6	12.50%		$0	$0	5	8.89%		$0	$0
	7	6.25%		$0	$0	7	12.50%		$0	$0	6	8.89%		$0	$0
	8	6.25%		$0	$0	8	5.00%		$0	$0	7	8.89%		$0	$0
						9	5.00%		$0	$0	8	8.89%		$0	$0
						10	5.00%		$0	$0	9	8.89%		$0	$0
Configuration 4	$\boxed{0}$	45.00%		$0	$0	$\boxed{0}$	30.00%		$0	$0	$\boxed{0}$	30.00%		$0	$0
(F-14)	1	25.00%		$0	$0	1	23.33%		$0	$0	1	23.33%		$0	$0
	2	20.00%		$0	$0	2	23.33%		$0	$0	2	23.33%		$0	$0
	3	10.00%		$0	$0	3	23.33%		$0	$0	3	23.33%		$0	$0
Configuration 5	4	2.00%		$0	$0	1	1.00%		$0	$0	$\boxed{0}$	20.00%		$0	$0
(Ships)	5	3.00%		$0	$0	2	1.00%		$0	$0	1	8.00%		$0	$0
	6	5.00%		$0	$0	3	1.00%		$0	$0	2	8.00%		$0	$0
	7	6.00%		$0	$0	4	1.00%		$0	$0	3	8.00%		$0	$0
	8	7.50%		$0	$0	5	3.00%		$0	$0	4	8.00%		$0	$0
	$\boxed{9}$	45.00%		$0	$0	6	5.00%		$0	$0	5	8.00%		$0	$0
	10	7.50%		$0	$0	7	5.00%		$0	$0	6	8.00%		$0	$0
	11	6.00%		$0	$0	8	10.00%		$0	$0	7	8.00%		$0	$0
	12	5.00%		$0	$0	9	10.00%		$0	$0	8	8.00%		$0	$0
	13	3.00%		$0	$0	$\boxed{10}$	25.00%		$0	$0	9	8.00%		$0	$0
	14	2.00%		$0	$0	11	10.00%		$0	$0	10	8.00%		$0	$0
	15	2.00%		$0	$0	12	10.00%		$0	$0					
	16	2.00%		$0	$0	13	5.00%		$0	$0					
	17	2.00%		$0	$0	14	5.00%		$0	$0					
	18	2.00%		$0	$0	15	3.00%		$0	$0					
						16	1.00%		$0	$0					
						17	1.00%		$0	$0					
						18	1.00%		$0	$0					
						19	1.00%		$0	$0					
						20	1.00%		$0	$0					

	FY 97					FY 98					FY 99				
	Qty	Weight %	Total Price	Avg Unit Price (AUP)	Weighted AUP	Qty	Weight %	Total Price	Avg Unit Price (AUP)	Weighted AUP	Qty	Weight %	Total Price	Avg Unit Price (AUP)	Weighted AUP
Configuration 6	$\boxed{0}$	45.00%		$0	$0	$\boxed{0}$	30.00%		$0	$0	$\boxed{0}$	30.00%		$0	$0
(AIA/E-8/ABCCC	1	25.00%		$0	$0	1	23.33%		$0	$0	1	23.33%		$0	$0
no CSP)	2	20.00%		$0	$0	2	23.33%		$0	$0	2	23.33%		$0	$0
	3	10.00%		$0	$0	3	23.33%		$0	$0	3	23.33%		$0	$0
Configuration 7	1	4.17%		$0	$0	1	3.13%		$0	$0	1	10.00%		$0	$0
(AIA/E-8/ABCCC	2	4.17%		$0	$0	2	3.13%		$0	$0	2	15.00%		$0	$0
with CSP)	3	4.17%		$0	$0	3	3.13%		$0	$0	3	15.00%		$0	$0
	4	4.17%		$0	$0	4	3.13%		$0	$0	$\boxed{4}$	20.00%		$0	$0
	5	7.50%		$0	$0	5	6.25%		$0	$0	5	15.00%		$0	$0
	6	7.50%		$0	$0	6	6.25%		$0	$0	6	15.00%		$0	$0
	$\boxed{7}$	45.00%		$0	$0	7	12.50%		$0	$0	7	10.00%		$0	$0
	8	7.50%		$0	$0	8	12.50%		$0	$0					
	9	7.50%		$0	$0	$\boxed{9}$	25.00%		$0	$0					
	10	4.17%		$0	$0	10	12.50%		$0	$0					
	11	4.17%		$0	$0	11	12.50%		$0	$0					
Configuration 8	$\boxed{1}$	45.00%		$0	$0	$\boxed{0}$	25.00%		$0	$0	$\boxed{0}$	20.00%		$0	$0
(MCE/TAOM CL2H)	2	15.00%		$0	$0	1	7.50%		$0	$0	1	5.33%		$0	$0
	3	15.00%		$0	$0	2	7.50%		$0	$0	2	5.33%		$0	$0
	4	12.50%		$0	$0	3	7.50%		$0	$0	3	5.33%		$0	$0
	5	12.50%		$0	$0	4	7.50%		$0	$0	4	5.33%		$0	$0
						5	7.50%		$0	$0	5	5.33%		$0	$0
						6	7.50%		$0	$0	6	5.33%		$0	$0
						7	7.50%		$0	$0	7	5.33%		$0	$0
						8	7.50%		$0	$0	8	5.33%		$0	$0
						9	7.50%		$0	$0	9	5.33%		$0	$0
						10	7.50%		$0	$0	10	5.33%		$0	$0
											11	5.33%		$0	$0
											12	5.33%		$0	$0
											13	5.33%		$0	$0
											14	5.33%		$0	$0
											15	5.33%		$0	$0
Configuration 9	3	6.25%		$0	$0	1	6.25%		$0	$0	$\boxed{0}$	30.00%		$0	$0
(MCE/ADCP/	4	6.25%		$0	$0	2	6.25%		$0	$0	1	23.33%		$0	$0
ATACC CL2)	5	7.50%		$0	$0	3	12.50%		$0	$0	2	23.33%		$0	$0
	6	7.50%		$0	$0	4	12.50%		$0	$0	3	23.33%			
	$\boxed{7}$	45.00%		$0	$0	$\boxed{5}$	25.00%		$0	$0					
	8	7.50%		$0	$0	6	12.50%		$0	$0					
	9	7.50%		$0	$0	7	12.50%		$0	$0					
	10	6.25%		$0	$0	8	6.25%		$0	$0					
	11	6.25%		$0	$0	9	6.25%		$0	$0					
Configuration 10	$\boxed{0}$	45.00%		$0	$0	$\boxed{0}$	30.00%		$0	$0	$\boxed{0}$	30.00%		$0	$0
(Submarine)	1	25.00%		$0	$0	1	23.33%		$0	$0	1	23.33%		$0	$0
	2	20.00%		$0	$0	2	23.33%		$0	$0	2	23.33%		$0	$0
	3	10.00%		$0	$0	3	23.33%		$0	$0	3	23.33%		$0	$0
CSP (In-Line)	$\boxed{0}$	45.00%		$0	$0	$\boxed{0}$	25.00%		$0	$0	$\boxed{0}$	20.00%		$0	$0
	1	11.00%		$0	$0	1	15.00%		$0	$0	1	16.00%		$0	$0
	2	11.00%		$0	$0	2	15.00%		$0	$0	2	16.00%		$0	$0
	3	11.00%		$0	$0	3	15.00%		$0	$0	3	16.00%		$0	$0
	4	11.00%		$0	$0	4	15.00%		$0	$0	4	16.00%		$0	$0
	5	11.00%				5	15.00%		$0	$0	5	16.00%		$0	$0
SRU BIT (In-Line)	$\boxed{0}$	45.00%		$0	$0	$\boxed{0}$	25.00%		$0	$0	$\boxed{0}$	20.00%		$0	$0
	1	11.00%		$0	$0	1	15.00%		$0	$0	1	16.00%		$0	$0
	2	11.00%		$0	$0	2	15.00%		$0	$0	2	16.00%		$0	$0
	3	11.00%		$0	$0	3	15.00%		$0	$0	3	16.00%		$0	$0
	4	11.00%		$0	$0	4	15.00%		$0	$0	4	16.00%		$0	$0
	5	11.00%				5	15.00%		$0	$0	5	16.00%		$0	$0
CSP/SRU BIT	$\boxed{0}$	45.00%		$0	$0	$\boxed{0}$	25.00%		$0	$0	$\boxed{0}$	20.00%		$0	$0
Retrofit Kits	1	11.00%		$0	$0	1	15.00%		$0	$0	1	16.00%		$0	$0
	2	11.00%		$0	$0	2	15.00%		$0	$0	2	16.00%		$0	$0
	3	11.00%		$0	$0	3	15.00%		$0	$0	3	16.00%		$0	$0
	4	11.00%		$0	$0	4	15.00%		$0	$0	4	16.00%		$0	$0
	5	11.00%		$0	$0	5	15.00%		$0	$0	5	16.00%		$0	$0

	FY 97					FY 98					FY 99				
	Qty	Weight %	Total Price	Avg Unit Price (AUP)	Weighted AUP	Qty	Weight %	Total Price	Avg Unit Price (AUP)	Weighted AUP	Qty	Weight %	Total Price	Avg Unit Price (AUP)	Weighted AUP
Misc Items Spares	1	7.50%		$0	$0	1	6.67%		$0	$0	$\boxed{1}$	25.00%		$0	$0
	2	7.50%		$0	$0	2	10.00%		$0	$0	2	12.50%		$0	$0
	3	7.50%		$0	$0	3	15.00%		$0	$0	3	12.50%		$0	$0
	4	12.50%		$0	$0	$\boxed{4}$	30.00%		$0	$0	4	12.50%		$0	$0
	$\boxed{5}$	45.00%		$0	$0	5	15.00%		$0	$0	5	12.50%		$0	$0
	6	12.50%		$0	$0	6	10.00%		$0	$0	6	12.50%		$0	$0
	7	7.50%		$0	$0	7	6.67%		$0	$0	7	12.50%		$0	$0
						8	6.67%		$0	$0					
R/T Spares	1	7.50%		$0	$0	1	5.00%		$0	$0	$\boxed{1}$	30.00%		$0	$0
	2	7.50%		$0	$0	2	5.00%		$0	$0	2	10.00%		$0	$0
	3	7.50%		$0	$0	3	5.00%		$0	$0	3	10.00%		$0	$0
	4	12.50%		$0	$0	4	5.00%		$0	$0	4	10.00%		$0	$0
	$\boxed{5}$	45.00%		$0	$0	5	5.00%		$0	$0	5	10.00%		$0	$0
	6	12.50%		$0	$0	6	10.00%		$0	$0	6	10.00%		$0	$0
	7	7.50%		$0	$0	$\boxed{7}$	30.00%		$0	$0	7	10.00%		$0	$0
						8	10.00%		$0	$0	8	10.00%		$0	$0
						9	5.00%		$0	$0					
						10	5.00%		$0	$0					
						20	5.00%		$0	$0					
						30	5.00%		$0	$0					
						40	5.00%		$0	$0					
DDP Spares	1	7.50%		$0	$0	1	5.00%		$0	$0	$\boxed{1}$	25.00%		$0	$0
	2	7.50%		$0	$0	2	5.00%		$0	$0	2	10.71%		$0	$0
	3	7.50%		$0	$0	3	5.00%		$0	$0	3	10.71%		$0	$0
	4	12.50%		$0	$0	4	5.00%		$0	$0	4	10.71%		$0	$0
	$\boxed{5}$	45.00%		$0	$0	5	5.00%		$0	$0	5	10.71%		$0	$0
	6	12.50%		$0	$0	6	10.00%		$0	$0	6	10.71%		$0	$0
	7	7.50%		$0	$0	$\boxed{7}$	30.00%		$0	$0	7	10.71%		$0	$0
						8	10.00%		$0	$0	8	10.71%		$0	$0
						9	5.00%		$0	$0					
						10	5.00%		$0	$0					
						20	5.00%		$0	$0					
						30	5.00%		$0	$0					
						40	5.00%		$0	$0					
HPA Spares	1	7.50%		$0	$0	1	4.38%		$0	$0	$\boxed{1}$	25.00%		$0	$0
	2	7.50%		$0	$0	2	4.38%		$0	$0	2	12.50%		$0	$0
	3	7.50%		$0	$0	3	4.38%		$0	$0	3	12.50%		$0	$0
	4	12.50%		$0	$0	4	7.50%		$0	$0	4	12.50%		$0	$0
	$\boxed{5}$	45.00%		$0	$0	5	10.00%		$0	$0	5	12.50%		$0	$0
	6	12.50%		$0	$0	$\boxed{6}$	30.00%		$0	$0	6	12.50%		$0	$0
	7	7.50%		$0	$0	7	10.00%		$0	$0	7	12.50%		$0	$0
						8	7.50%		$0	$0					
						9	4.38%		$0	$0					
						10	4.38%		$0	$0					
						11	4.38%		$0	$0					
						12	4.38%		$0	$0					
						13	4.38%		$0	$0					
E-3 IU Spares	$\boxed{0}$	45.00%		$0	$0	$\boxed{0}$	30.00%		$0	$0	$\boxed{0}$	30.00%		$0	$0
	1	25.00%		$0	$0	1	23.33%		$0	$0	1	23.33%		$0	$0
	2	20.00%		$0	$0	2	23.33%		$0	$0	2	23.33%		$0	$0
	3	10.00%		$0	$0	3	23.33%		$0	$0	3	23.33%		$0	$0
E-3 CDU Spares	$\boxed{0}$	45.00%		$0	$0	$\boxed{0}$	30.00%		$0	$0	$\boxed{0}$	30.00%		$0	$0
	1	25.00%		$0	$0	1	23.33%		$0	$0	1	23.33%		$0	$0
	2	20.00%		$0	$0	2	23.33%		$0	$0	2	23.33%		$0	$0
	3	10.00%		$0	$0	3	23.33%		$0	$0	3	23.33%		$0	$0
E-3 PDU Spares	$\boxed{0}$	45.00%		$0	$0	$\boxed{0}$	30.00%		$0	$0	$\boxed{0}$	30.00%		$0	$0
	1	25.00%		$0	$0	1	23.33%		$0	$0	1	23.33%		$0	$0
	2	20.00%		$0	$0	2	23.33%		$0	$0	2	23.33%		$0	$0
	3	10.00%		$0	$0	3	23.33%		$0	$0	3	23.33%		$0	$0

		FY 97					FY 98					FY 99			
	Qty	Weight %	Total Price	Avg Unit Price (AUP)	Weighted AUP	Qty	Weight %	Total Price	Avg Unit Price (AUP)	Weighted AUP	Qty	Weight %	Total Price	Avg Unit Price (AUP)	Weighted AUP
F-15 IU Spares	**0**	45.00%		$0	$0	**1**	30.00%		$0	$0	**0**	30.00%		$0	$0
	1	25.00%		$0	$0	2	5.83%		$0	$0	1	23.33%		$0	$0
	2	20.00%		$0	$0	3	5.83%		$0	$0	2	23.33%		$0	$0
	3	10.00%		$0	$0	4	5.83%		$0	$0	3	23.33%		$0	$0
						5	5.83%		$0	$0					
						6	5.83%		$0	$0					
						7	5.83%		$0	$0					
						8	5.83%		$0	$0					
						9	5.83%		$0	$0					
						10	5.83%		$0	$0					
						15	5.83%		$0	$0					
						20	5.83%		$0	$0					
						22	5.83%		$0	$0					
MCE IU Spares	**0**	45.00%		$0	$0	1	17.50%		$0	$0	**0**	45.00%		$0	$0
	1	25.00%		$0	$0	**2**	30.00%		$0	$0	1	18.33%		$0	$0
	2	20.00%		$0	$0	3	17.50%		$0	$0	2	18.33%		$0	$0
	3	10.00%		$0	$0	4	17.50%		$0	$0	3	18.33%		$0	$0
						5	17.50%		$0	$0	4	12.50%		$0	$0
Navy IU Spares	**0**	45.00%		$0	$0	**0**	30.00%		$0	$0	**0**	30.00%		$0	$0
	1	25.00%		$0	$0	1	23.33%		$0	$0	1	23.33%		$0	$0
	2	20.00%		$0	$0	2	23.33%		$0	$0	2	23.33%		$0	$0
	3	10.00%		$0	$0	3	23.33%		$0	$0	3	23.33%		$0	$0
Ship IU Spares	1	7.50%		$0	$0	1	6.67%		$0	$0	**1**	60.00%		$0	$0
	2	7.50%		$0	$0	2	10.00%		$0	$0	2	20.00%		$0	$0
	3	7.50%		$0	$0	3	15.00%		$0	$0	3	20.00%		$0	$0
	4	12.50%		$0	$0	**4**	30.00%		$0	$0					
	5	45.00%		$0	$0	5	15.00%		$0	$0					
	6	12.50%		$0	$0	6	10.00%		$0	$0					
	7	7.50%		$0	$0	7	6.67%		$0	$0					
						8	6.67%		$0	$0					
Ship ICP Spares	1	7.50%		$0	$0	1	6.67%		$0	$0	**1**	60.00%		$0	$0
	2	7.50%		$0	$0	2	10.00%		$0	$0	2	20.00%		$0	$0
	3	7.50%		$0	$0	3	15.00%		$0	$0	3	20.00%		$0	$0
	4	12.50%		$0	$0	**4**	30.00%		$0	$0					
	5	45.00%		$0	$0	5	15.00%		$0	$0					
	6	12.50%		$0	$0	6	10.00%		$0	$0					
	7	7.50%		$0	$0	7	6.67%		$0	$0					
						8	6.67%		$0	$0					
Misc Spares	**1**	45.00%		$0	$0	**0**	30.00%		$0	$0	**0**	30.00%		$0	$0
	2	20.00%		$0	$0	1	23.33%		$0	$0	1	23.33%		$0	$0
	3	10.00%		$0	$0	2	23.33%		$0	$0	2	23.33%		$0	$0
	4	6.25%		$0	$0	3	23.33%		$0	$0	3	23.33%		$0	$0
	5	6.25%		$0	$0										
	6	6.25%		$0	$0										
	7	6.25%		$0	$0										
Sum of BEQ Total Prices			$0					$0					$0		
Total Wgtd AUP - Sum of Wght AUP's					$0					$0					$0

Note: Qty in **BOLD BOX** is Government's BEQ.

Qty = The range of quantities for each End Item
Weight % = weight given to a particular quantity
Total Price = Offeror's extended price for the identified quantities
Average Unit Price (AUP) = Total Price/Qty
Weighted AUP = AUP * Weight %

	Ktr A	Ktr B
Price Evaluation:		
Total Weighted AUP FY97	$0	$0
Total Weighted AUP FY98	$0	$0
Total Weighted AUP FY99	$0	$0
Total Weighted AUP All FYs	$0	$0
Total Non Warranty Repair (FY98 - FY01)	$0	$0
Total Engineering Services/Install Support	$0	$0
Data	$0	$0
GFE/STE	$0	$0
Evaluation Price	$0	$0

The Price Evaluation will be carried out as follows:

1) The offerors will insert total prices for each quantity in each FY.

2) Each Average Unit Price (AUP) will be calculated by dividing Total Price by Quantity

3) A Weighting Factor, as identified in the Tables, will be applied to each AUP for each quantity to form a Weighted AUP

4) The results for 3) above will be summed by FY and then the FY's will be summed to form the Total Weighted AUP All FYs

5) Next, Total Non Warranty Repair for all FYs (FY98 - FY01) will be calculated. The value to be used in this calculation will be determined by multiplying each Terminal Configuration's BEQ Labor Hours times the appropriate Hourly labor rate and summing the resulting values. The total FY sums for all Configurations will be summed to form the Total Non Warranty Repair (FY98-FY01). See example #1 below.

6) Total Engineering Services/Installation Support for all FYs will be added to 4) and 5) above. See example #2 below.

7) Next, total data price for FY 97 will be divided by the BEQ terminal quantity.

8) Lastly, GFE/STE is added to 4), 5), 6), and 7) above to form the Evaluated Price (see GFE/STE Cost Format 2 for proper instructions)

Example #1:

Configuration 1 Non Warranty Repair (NWR)

	Est. Hrs per Term	Loaded Hr. Labor Rate FY98	Ext Labor $ FY98	Loaded Hr. Labor Rate FY99	Ext Labor $ FY99	Loaded Hr. Labor Rate FY00	Ext Labor $ FY00	Loaded Hr. Labor Rate FY01	Ext Labor $ FY01	Total All FYs
Program Manager	10	$80	$800	$84	$840	$88	$882	$93	$926	$3,448
Clerical	12	$30	$360	$32	$378	$33	$397	$35	$417	$1,552
Engr Labor Cat II	12	$70	$840	$74	$882	$77	$926	$81	$972	$3,621
Engr Labor Cat IV	110	$55	$6,050	$58	$6,353	$61	$6,670	$64	$7,004	$26,076
PP&C Administrator	12	$60	$720	$63	$756	$66	$794	$69	$833	$3,103
Lab Technician	26	$50	$1,300	$53	$1,365	$55	$1,433	$58	$1,505	$5,603
Mfg Test Technician	67	$60	$4,020	$63	$4,221	$66	$4,432	$69	$4,654	$17,327
Industrial Engr	12	$70	$840	$74	$882	$77	$926	$81	$972	$3,621
Assembler	43	$45	$1,935	$47	$2,032	$50	$2,133	$52	$2,240	$8,340
Mfg Inspector	27	$50	$1,350	$53	$1,418	$55	$1,488	$58	$1,563	$5,819
Total			**$18,215**		**$19,126**		**$20,082**		**$21,086**	**$78,509**

Assuming that all 10 Configurations have the same amount of Labor hours the Total Non Warranty Repair All FYs = 10 * $78,509 = $785,090
This value ($785,090) is the value for 5) above.

Example #2:

Terminal Configuration	Man Days	Loaded Man Day Labor Rate FY98	Ext Labor $ FY98	Loaded Man Day Labor Rate FY99	Ext Labor $ FY99	Loaded Man Day Labor Rate FY00	Ext Labor $ FY00	Loaded Man Day Labor Rate FY01	Ext Labor $ FY01	Total All FYs
1	5	$500	$2,500	$525	$2,625	$551	$2,756	$579	$2,894	$10,775
2	5	$500	$2,500	$525	$2,625	$551	$2,756	$579	$2,894	$10,775
3	5	$500	$2,500	$525	$2,625	$551	$2,756	$579	$2,894	$10,775
4	5	$500	$2,500	$525	$2,625	$551	$2,756	$579	$2,894	$10,775
5	5	$500	$2,500	$525	$2,625	$551	$2,756	$579	$2,894	$10,775
6	5	$500	$2,500	$525	$2,625	$551	$2,756	$579	$2,894	$10,775
7	5	$500	$2,500	$525	$2,625	$551	$2,756	$579	$2,894	$10,775
8	5	$500	$2,500	$525	$2,625	$551	$2,756	$579	$2,894	$10,775
9	5	$500	$2,500	$525	$2,625	$551	$2,756	$579	$2,894	$10,775
10	5	$500	$2,500	$525	$2,625	$551	$2,756	$579	$2,894	$10,775
Total Install Support/Eng Services			**$25,000**		**$26,250**		**$27,563**		**$28,941**	**$107,753**

The value calculated for this example, $107,753, is the value used in 6) above.